"Make treacle the fluid of levels, and they will all be sluggish; long or short radii, *i. e.* after a certain angular tilt, the bubbles will be moving slowly for a long time before coming to their new point of rest.

"Put ether into a tube of long radius; it moves *quickly* in the above case from want of sluggish nature, and moves *far*, by reason of the long radius. Put ether into a tube of very short radius, men say how sluggish, because it does not move far, measured in the linear way. But they should rather ascertain which bubble comes to its new place of rest soonest; and if by reason of short radius they cannot easily see what arc one bubble moves through, they can increase the radius optically by magnifying. Now by mere optical magnifying, the bubble has no mechanical friction added to its motion; but if the magnifying be by increasing the radius of the level, the bubble has a greater mechanical task of walking along so much more in length of glass surface.

"Hence it may be shown that these new short-radius levels viewed through magnifiers, are as accurate, and quicker in their motions of *angle*, than the usual ones of long radii looked at with the naked eye.

"All fluids have more or less of the sluggishness or stickiness so greatly developed in treacle; alcohol has less than water; ether the Germans found to have less than alcohol; and chloroform I have found to have less than ether: while it has the great advantage (seeing that the end of tube must be hermetically sealed with a blow-pipe flame), over both ether and alcohol, of not being inflammable."

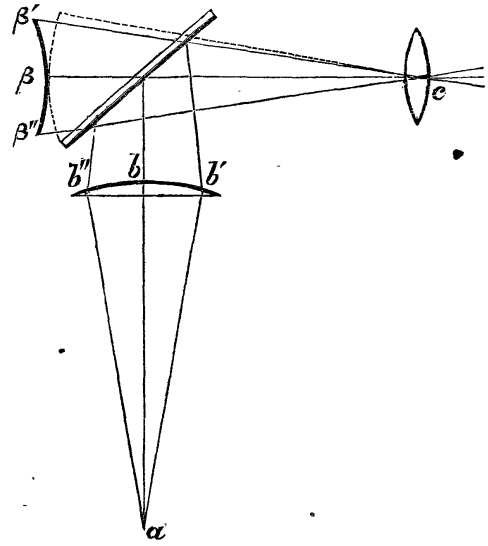
He also mentions that practically a good range of arc is 5°, and a good radius, 9 feet.

Note on the above Communication. By Rev. Baden Powell, M.A., F.R.S., &c., Savilian Professor of Geometry, Oxford.

Professor C. P. Smyth's new artificial horizon has been very briefly and generally described by him in communications to the Royal Scottish Society of Arts, to the Royal Astronomical Society (*Notices*, xvii. 37), and in the Descriptive Catalogue of the French Exhibition, 1855, where the instrument itself was seen. But no detailed account of the *principle* of the construction has appeared. The writer of this note having requested such an account from the inventor, has also obtained his consent to lay it before the Royal Astronomical Society, as its importance well deserves. But to render it complete, it appeared to him that a more precise elucidation of the *optical* principle involved was desirable; this may be most distinctly stated as follows:—

1. The tube of the spirit-level being a small arc of a circle of considerable radius, within the limits of this arc, the true horizontal line is the tangent to that point of the arc at which the

bubble appears; and in any successive positions, the change of inclination is measured by the angle of intersection of the tangents, which is the same as the arc of the tube traversed by the bubble, or the angle at the centre (a).



2. Taking the chord of this arc as the base, a plane mirror inclined at 45° to it above, gives for the reflected image of the level-tube a similar arc *convex* towards it.

3. A lens placed in front of the mirror, having its principal focal length equal to the distance of the image of the bubble when at the middle point of the arc, and adjusted to receive centrically the reflected diverging pencil from the bubble will cause it to emerge in a parallel pencil, thus placing the image at an infinite distance, and enabling us to view it through a telescope.

4. In other positions of the bubble (*since the convexity is towards the lens*), it will not be accurately in focus; though it will be approximately so if the focal length be considerable, so that the small difference in the length of the rays from the middle point, and from the two extremities, may be neglected.

5. If the base be accurately horizontal, and consequently the bubble (b), in the middle of the arc to which the index is adjusted, the axis of the reflected pencil from its image (β) passing through the centre of the lens (c), will be accurately horizontal; or the image seen through the lens gives the true horizontal point, this adjustment is supposed accurately made in the first instance once for all.

6. If the base (the lens and mirror being firmly attached to it), be inclined either way, within the limits of the arc, any change in the position of the bubble measured on the *arc* of the tube ($b'\,b''$), will be exactly equal to the change measured on the *arc* of the reflected image ($\beta'\,\beta''$).

7. If the focal length of the lens be equal to the radius of the arc of the level ($b\,a$), and if the distance were accurately the same from the lens (c) to all points of the reflected arc ($\beta'\beta''$) (as it would be if the image were *concave* towards the lens), then for any change of *arc* (as from β' to β'') there would be an exactly equal change of *angle* in the rays at (c), and as in the middle position the reflected ray ($\beta\,c$) is exactly horizontal, so in every other position would the reflected rays ($\beta' c$) ($\beta'' c$) for those positions respectively give the true horizontal point.

8. But since the image is *convex* towards (c), the angle at c

is (in strictness) less than the angle at *a*. Yet if the radius or focal length be large, and the arc small, the conditions will be so approximately fulfilled, that without sensible error, the change of *angle* will be equal to the change of *arc*, or of *inclination to the horizon*, and consequently *the reflected ray will give the true horizontal point without sensible error at all inclinations within the limits.*

Professor C. P. Smyth's invention becomes of peculiar value (in combination with his free-revolver stand), since the attainment of an artificial horizon on board ship has been in vain sought in any applications of the ordinary spirit-level, of liquid reflecting surfaces, by simple suspension in equilibrio, or by the rotating plane reflector of Troughton's top ; the failures of which are demonstrable on mechanical grounds.

But the invention may become of not less importance to observers on land, and especially to scientific travellers, from its portability and exemption from the disturbances incident to liquid reflectors.

Results of the Observations of Small Planets made at the Royal Observatory, Greenwich, from Dec. 4 to Dec. 31, 1857.

(*Communicated by the Astronomer Royal.*)

Metis.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1857, Dec. 10	11 21 44·5	4 40 15·01	66 34 41·81
19	10 37 6·7	4 30 58·91	66 21 17·99

Hygeia.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1857, Dec. 5	8 30 17·6	1 28 37·19	75 52 6·53
19	7 34 23·2	1 27 45·39	76 18 18·27

Irene.

Mean Solar Time of Observation.	Apparent R.A.	Apparent N.P.D.
	h m s	h m s	° ′ ″
1857, Dec. 7	9 49 19·8	2 55 45·49	80 37 26·08
10	9 35 28·4	2 53 41·44	80 34 7·10